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Picea orientalis

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Arboretum Activities

MICHAUX QUERCETUM

Previous issues of this Bulletin[1] have carried accounts of the Michaux Quercetum, a project jointly sponsored by the Arboretum and the Northeastern Forest Experiment Station of the U.S. Department of Agriculture and supported in part by a grant from the Michaux Fund of the American Philosophical Society.

Briefly, this undertaking is concerned with the growing and study of as many different species of oaks as will prove hardy in the Philadelphia area. To this end we have enlisted the cooperation of collectors throughout this country and abroad and to date 255 seedlots have been received, repre-

[1] Vol. 5:54-57, 1954. Vol. 6:45-48, 1955.

(Continued on page 57)

An Illustrated Key to the Genera of Conifers

HUI-LIN LI

The following artificial key is prepared to provide a ready means of identifying the genera of conifers, native as well as cultivated, by leaf specimens only. In nearly all manuals of trees and shrubs the keys use both vegetative and reproductive characters; thus it often proves impractical to identify any plant without complete material. Reproductive features are here used only occasionally as a supplement to vegetative characters.

The key includes all genera native to and cultivated in the United States. A few genera not hardy in the Philadelphia area and farther north are marked with an asterisk (*). As few technical terms as possible are employed; thus an amateur botanist will be able to use it without consulting a botanical glossary. To explain more explicitly and graphically certain points that usually confound one in identifying some of the genera, a number of sketches and diagrams are given, which can be consulted when using the key.

The term "conifers" is here used in the broadest sense to include both true conifers and taxads. The taxads are generally distinguishable from the true conifers in that the ovules are solitary or few and these do not organize into "cones," which give the name to the conifers. With the exception of *Podocarpus, Cephalotaxus, Taxus,* and *Torreya,* all genera listed below are true conifers.

A very brief summary of each of the genera follows the key. These genera are listed alphabetically by their scientific name, followed by their respective common name. It should be noted that many of the common names are the same as the scientific names and that it is the general tendency in both botany and horticulture to use more and more scientific generic names as common names, not only among conifers but among other plant groups as well. For instance, *Cephalotaxus* is known as Plum-Yew, but Cephalotaxus is now also gaining in general usage to replace Plum-Yew as a common name.

The key has been used and tested at various times and occasions, among which are the classes in the course on "Woody Plant Material" which was conducted at the Arboretum during the past two summers. Suggestions for further improvements from others who may use it are sincerely solicited.

A. Leaves linear, flat or angular, or needle-like.
  B. Leaves in clusters or whorls.
    C. Leaves linear, large and flat, 5-12 cm. long and about 3 mm. wide, arranged in whorls of 10-30. — *Sciadopitys*
    CC. Leaves needle-like or linear, to 3 mm. or less wide, in whorls or clusters.
      D. Leaves needle-like or scale-like, in whorls of 3 or clusters of 2-5.
        E. Leaves 2, 3 or 5 in a cluster, very slender, 2.5 cm. or more long; cones large, dry. — *Pinus*
        EE. Leaves in whorls of 3, needle-like or scale-like, short and stiff, to 2 cm. long, usually much shorter; cones small, fleshy or woody.
          F. Leaves needle-like, to 2 cm. long, usually much shorter, in whorls of 3 or clusters of 2-5; cones fleshy, berry-like. — *Juniperus*
          FF. Leaves scale-like, 3 mm. long, in whorls of 3; cones woody. — *Fitzroya**
      DD. Leaves mostly linear or flattened, or sometimes needle-like, 10 or more clustered on short lateral shoots. (Fig. 19).
        E. Leaves deciduous, linear, mostly flattened, soft.
          F. Short lateral shoots longer, club-shaped, with distinct annual rings; bud-scales persistent, acuminate; leaves wider, to 2 mm. broad; cones breaking up when ripe. — *Pseudolarix*
          FF. Short lateral shoots shorter, cylindrical, with less distinct annual rings; bud-scales deciduous, obtuse; leaves narrower, to 1.5 mm. wide; cone-scales persistent. — *Larix*
        EE. Leaves evergreen, needle-like, pointed, rigid. — *Cedrus*
  BB. Leaves not in clusters but opposite, alternate or spirally arranged.
    C. Leaves needle-like or awl-shaped, spirally arranged or opposite.
      D. Leaves opposite, needle-like; cones small, fleshy or woody.
        E. Leaves with whitish marks above; cones fleshy. — *Juniperus*
        EE. Leaves with whitish marks beneath; cones woody. — *Chamaecyparis*
      DD. Leaves linear, awl-shaped, spirally arranged; cones larger woody.
        E. Leaves strongly keeled. — *Cryptomeria*
        EE. Leaves not or only slightly keeled. — *Sequoiadendron*
    CC. Leaves linear, more or less flattened or sometimes angular.

D. Leaves and lateral branches deciduous; leaves light green and soft. (Fig. 20).
E. Leaves and lateral branches alternate. — *Taxodium*
EE. Leaves and lateral branches opposite. — *Metasequoia*
DD. Leaves evergreen, bright to dark green.
E. Leaves decurrent; branches without conspicuous leaf-scars.
F. Leaves radially spreading, very stiff-spiny pointed, green on both surfaces. — *Araucaria**
FF. Leaves spreading in 2 ranks, with 2 whitish bands beneath.
G. Leaves distinctly and rigidly spiny pointed.
H. Leaves bright green, gradually narrowed into a long stiff spiny point, with a broad base and with 2 broad whitish bands beneath. (Fig. 22). — *Cunninghamia*
HH. Leaves dark green, abruptly narrowed into a very short spiny point, with a narrow base and with 2 narrow whitish or brownish bands beneath.
I. Leaf-points sharp to touch. (Fig. 21B). — *Torreya*
II. Leaf-points not sharp to touch. — *Podocarpus* in part*
GG. Leaves shortly pointed, not spiny, the tips blunt.
H. Branchlets opposite; leaves 2-8 cm. or more long, abruptly narrowed into a short petiole; terminal buds usually 3. (Fig. 21C). — *Cephalotaxus*
HH. Branchlets alternate; leaves short, 2.5 cm. or less long, narrowing gradually to the base; terminal bud solitary.
I. Leaves with 2 pale green to tawny-yellow broad bands beneath; bud-scales rounded. (Fig. 21A). — *Taxus*
II. Leaves with 2 whitish broad bands beneath; bud scales acute.
J. Leaves distinctly 2-ranked; main branches not whorled.
K. Leaves dimorphic, those of lateral shoots linear, those of long shoots scale-like; tall trees. — *Sequoia**
KK. Leaves all alike, without scale-like ones; low trees or shrubs. — *Podocarpus* in part*
JJ. Leaves indistinctly 2-ranked, slightly twisted; main branches whorled. — *Saxegothaea**
EE. Leaves not decurrent; branches with conspicuous smooth or raised leaf-scars. (Fig. 23).
F. Branches roughened by persistent distinctly raised leaf-scars.
G. Leaves with a short petiole and with whitish bands beneath or on both surfaces; main branches usually not whorled. — *Tsuga*
GG. Leaves sessile, with whitish bands above; main branches usually whorled. — *Picea*
FF. Branches smooth or nearly smooth, not roughened by leaf-scars.
G. Leaf-scars disc-like, circular, not colored; leaves more or less stiff; buds roundish to oblong, blunt or pointed.
H. Leaves flattened, keeled above, pale green below; buds roundish. — *Keteleeria**
HH. Leaves flattened, grooved above, sometimes 4-angled, usually with whitish bands beneath; buds oblong. — *Abies*
GG. Leaf-scars oval, colored; leaves soft to the touch; buds spindle-shaped, sharp-pointed. — *Pseudotsuga*
AA. Leaves (mature adult ones) small and scale-like, opposite, more or less appressed to the stem. (Fig. 24).
B. Branch systems in flattened sprays, frond-like.
C. Branch systems spreading in horizontal planes or arising at different planes, usually paler green beneath.
D. Leaves of alternate pairs of more or less equal length and size.
E. Leaves smaller, 1.5-3 mm. long; cones rounded, the scale 4-sided, with a distinct boss in the center of each. — *Chamaecyparis* in part
EE. Leaves larger, 2.5-6 mm. long; cones conical, the scale thin, pointed.
F. Branchlets slender, to 4 mm. broad; leaves with or without white markings beneath, the lateral leaves appressed to the stem. — *Thuja*
FF. Branchlets much flattened, 5-6 mm. broad; leaves with conspicuous white batches beneath, the lateral ones somewhat spreading. — *Thujopsis*
DD. Leaves of alternate pairs of very unequal size, the lateral ones much larger than and nearly covering the facial ones.
E. Leaves narrow, oblong, sharp-pointed, 2-3 times as long as broad, bright green on both surfaces. — *Heyderia (Libocedrus)*
EE. Leaves ovate, blunt to slight pointed, less than 2 times as long as broad, whitish beneath. — *Chamaecyparis* in part
CC. Branch systems spreading in vertical planes, green on both sides. — *Biota*
BB. Branch systems not in flattened sprays.
C. Leaves all scale-like; cones woody. — *Cupressus* in part*
CC. Both scale-like and needle-like leaves often present on the same plant; cones fleshy, berry-like. — *Juniperus* in part

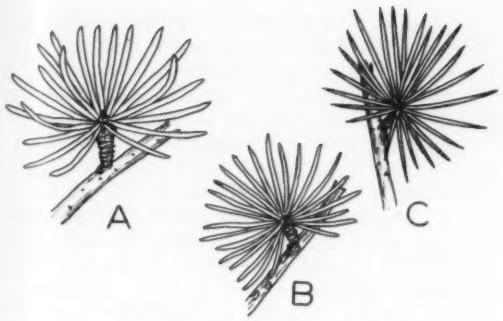

Fig. 19. Foliage of (A) *Pseudolarix amabilis*, (B) *Larix decidua*, and (C) *Cedrus libani*. × ½

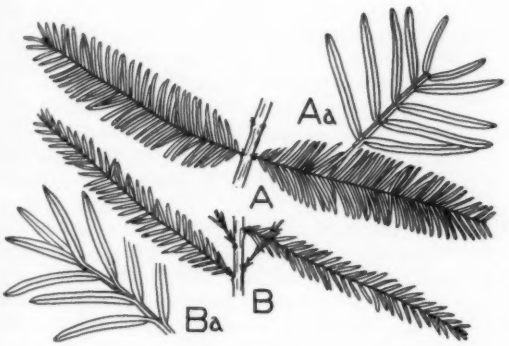

Fig. 20. Foliage of (A) *Metasequoia glyptostroboides* and (B) *Taxodium distichum*. A & B × ½. Aa & Ba × 1½

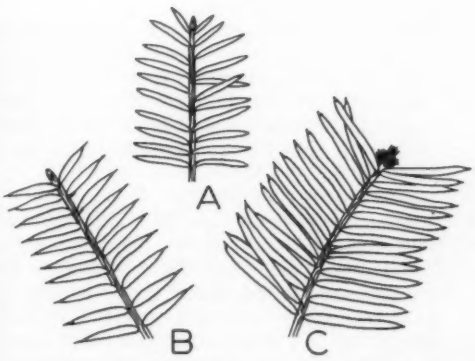

Fig. 21. Foliage of (A) *Taxus baccata*, (B) *Torreya nucifera*, and (C) *Cephalotaxus drupacea*. × ½

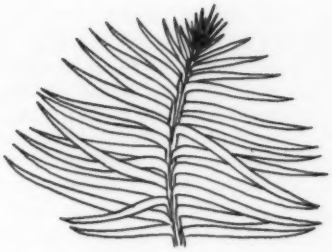

Fig. 22. *Cunninghamia lanceolata*. × ½

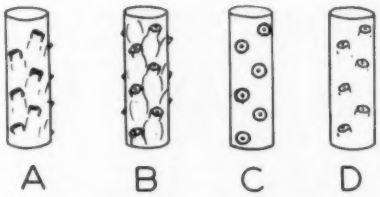

Fig. 23. Diagrams showing leaf-scars of (A) *Tsuga*, (B) *Picea*, (C) *Abies*, and (D) *Pseudotsuga*.

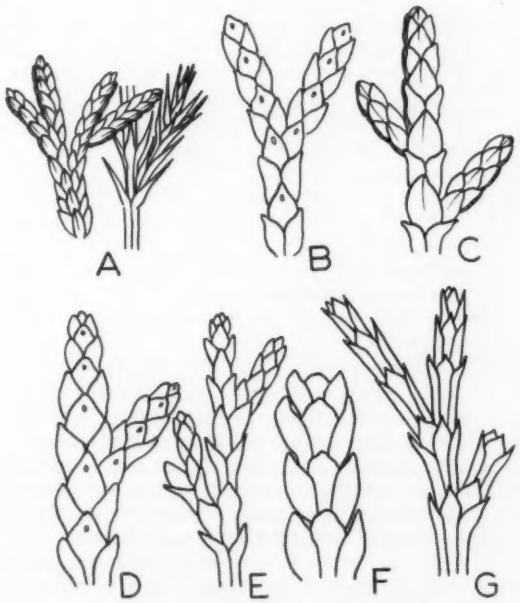

Fig. 24. Foliage of (A) *Juniperus virginiana*, (B) *Chamaecyparis Lawsoniana*, (C) *Cupressus macrocarpa*, (D) *Thuja occidentalis*, (E) *Biota orientalis*, (F) *Thujopsis dolobrata*, and (G) *Heyderia decurrens*. × 3

1. ABIES Fir (Fig. 23C)

There are about 40 species widely distributed in the mountains and the cooler parts of the Northern Hemisphere. Many of these are in cultivation. Most of them grow best in a cool and humid climate. Some of the western North American species like Colorado Fir, *A. concolor* and Noble Fir, *A. nobilis,* and Asiatic species like Nikko Fir, *A. homolepis* of Japan and Farges Fir, *A. Fargesii* of China, do very well in the eastern states, while other species from Asia and Europe do not prove satisfactory.

2. ARAUCARIA Southern Pine

There are about 20 species, all of the Southern Hemisphere and the tropics. The Monkey-Puzzle, *A. araucana* of Chile, is the hardiest species, and can be grown in the open as far north as southern New Jersey.

3. BIOTA Oriental Arbor Vitae (Fig. 24E)

The only species, *B. orientalis* from eastern Asia, is sometimes included in the genus *Thuja.* Numerous forms of this tree with different habit occur in cultivation and can be adapted for various purposes in landscaping.

4. CEDRUS Cedar (Fig. 19C)

The true Cedars are among the most valuable ornamental trees. Three of the 4 species are in cultivation: Atlas Cedar, *C. atlantica* of North Africa, Cedar of Lebanon, *C. libani* of western Asia, and Deodar Cedar, *C. deodara* of the Himalayas. The latter is not always hardy in the Philadelphia region.

5. CEPHALOTAXUS Plum-Yew (Fig. 21C)

This is a small genus of Eastern Asia, with 2 of its 8 or 9 species more or less common in cultivation, namely, Japanese Plum-Yew, *C. drupacea* and Chinese Plum-Yew, *C. Fortuni.* These plants resemble the Yews but are more graceful in appearance because of their longer foliage.

6. CHAMAECYPARIS Cypress (Fig. 24B)

The genus with its 6 species is confined to Formosa and Japan in eastern Asia and the Pacific and Atlantic coasts in North America. The eastern American *C. thyoides,* White Cedar, is the smallest and the least attractive. The western American *C. nootkatensis,* Nootka Cypress, and *C. Lawsoniana,* Lawson Cypress, do not do so well in the eastern United States as the two Japanese species, *C. obtusa,* Hinoki Cypress, and *C. pisifera,* Sawara Cypress. These two latter species include many horticultural forms.

7. CRYPTOMERIA Cryptomeria

There is a single species in China and Japan, extensively cultivated, especially in the latter country, as a forest and ornamental tree. It is frequently planted, particularly the form 'Lobbii,' in the Philadelphia region, doing well in certain locations but subject to much winter browning in others.

8. CUNNINGHAMIA Chinese Fir (Fig. 22)

There are 2 species in China, one, *C. lanceolata,* is the most important timber tree there. A distinctive looking tree with its bright green long spiny leaves, it is hardy in the Philadelphia area but does not do so well as in regions farther south.

9. CUPRESSUS Cypress (Fig. 24C)

There are some 12 species in North Africa, Asia and western North America. Most of these species are tender and can be planted only in mild climates.

10. FITZROYA Fitzroya

There is a single species, *F. cupressoides,* a tree in southern Chile, its native habitat, but it often becomes shrubby in cultivation. The tree is not hardy in the open in Philadelphia.

11. HEYDERIA Incense Cedar (Fig. 24G)

The 3 species of Incense Cedars of the Northern Hemisphere were formerly included in *Libocedrus,* a genus now considered distinct and exclusively of the Southern Hemisphere. The California species, *H. decurrens,* with a very distinct columnar habit, is hardy in the Philadelphia region but is of very slow growth.

12. JUNIPERUS Juniper (Fig. 24A)

There are some 60 species widely distributed in the Northern Hemisphere; about half of these are now in cultivation. The different species of this genus adapt to a wide variety of soil and climate conditions. The most commonly planted species are Common Juniper, *J. communis,* Chinese Juniper, *J. chinensis,* and Red Cedar, *J. virginiana,* each running into numerous garden forms.

13. KETELEERIA Keteleeria

There are about 4 species in southern China, trees resembling closely Firs in general appearance, but adapt more to warmer and dryer conditions. *K. Davidiana* is the most commonly planted species and probably the hardiest, but it can not be grown as far north as Philadelphia.

14. LARIX Larch (Fig. 19B)

There are about 11 species in the mountains and northern parts of the Northern Hemisphere, most of them in cultivation. The Larches are tall deciduous trees. Among the most commonly cultivated species are European Larch, *L. decidua* and American Larch, *L. laricina.* The Japanese Larch, *L. leptolepis* and Dahurian Larch, *L. Gmelini,* are also frequently planted and have proven satisfactory.

15. METASEQUOIA Metasequoia (20A)

There is a single species, *M. glyptostroboides,* a relatively recent discovery from central China. The tree is deciduous, resembling the Bald Cypress in foliage, but with opposite instead of alternate branchlets and leaves. It has proven to be not only a highly ornamental tree but also a rapid grower, hardy to cold climates and free of diseases.[1]

16. PICEA Spruce (23B)

There are about 30 species widely distributed in the colder parts of the Northern Hemisphere. A large number of the species are in cultivation. Among the most widely used species are Norway Spruce, *P. Abies,* White Spruce, *P. glauca,* and Blue Spruce, *P. pungens.* On the whole, the European species are doing better in the eastern states than species from Asia.

17. PINUS Pine

The Pines are among the best known and most widely planted trees. There are about 80 species widely distributed throughout the Northern Hemisphere. At least half of that number are in cultivation. Especially outstanding among the exotic ornamental species are Himalayan Pine, *P. Griffithii,* valued for its long graceful foliage, Lace Bark Pine, *P. Bungeana,* for its chalky white bark, and Japanese White Pine, *P. parviflora,* for its reddish bark and its picturesque form (assumed usually through grafting).

18. PODOCARPUS Podocarpus

There are about 70 species widely distributed in the Southern Hemisphere and the tropics. Only a few species, mostly from eastern Asia, are cultivated in subtropical or warm temperate regions or in the greenhouse in the north.

19. PSEUDOLARIX Golden Larch (Fig. 19A)

There is a single species, *P. amabilis* from eastern China, a deciduous tree resembling closely the Larches. This handsome tree has a well balanced, broad-pyramidal shape and feathery bright green foliage. The tree is slow in growth and does not like limy soil.

20. PSEUDOTSUGA Pseudotsuga (Fig. 23D)

There are 6 species in the genus, 4 in eastern Asia and 2 in Pacific North America. The Asiatic species are more or less rare plants and are also rare in cultivation. The American species, *P. taxifolia,* Douglas Fir, a variable plant, is most widely planted.

21. SAXEGOTHAEA Prince Albert Yew

There is a single species in southern Chile, *S. conspicua,* a small tree occasionally planted in warm regions.

22. SCIADOPITYS Umbrella Pine

There is a single species, *S. verticillata,* peculiar to Japan, a celebrated ornamental tree. It is slow growing in cultivation and it grows best in retentive moist soil. The tree, with its exceptionally long and broad needles and dense pyramidal habit, is very distinct in its appearance.

23. SEQUOIA Redwood

The only species, *S. sempervirens,* the well known Redwood of California, is a lover of moisture and a characteristic tree of the coastal fog belt in northern California. Unfortunately this famous tree is not hardy in the Morris Arboretum although it can be grown in more southern areas.

24. SEQUOIADENDRON Big Tree

The only species, *S. giganteum,* is the largest of all trees. Its original range in California is restricted to a narrow belt along the western slope of the Sierra Nevada. In cultivation this tree barely survives in the Philadelphia region and is very slow in its growth here.

25. TAXODIUM Deciduous Cypress (20B)

There are 3 species, 2 in southeastern United States and 1 in Mexico. The 2 northern species are semi-aquatic trees growing in or near water or in low swamps. Both the Bald Cypress, *T. distichum,* and Pond Cypress, *T. ascendens,* grow well in the Philadelphia area, in swampy as well as upland locations. The latter is sometimes mistaken for *Glyptostrobus,* an Asiatic genus which is not hardy here.

26. TAXUS Yew (Fig. 21A)

There are about 7 species widely distributed in Europe, Asia and North America, sometimes treated as varieties or races of one species as they very closely resemble each other and are often difficult to distinguish. The most widely planted species are English Yew, *T. baccata* and Japanese Yew, *T. cuspidata,* each running into many garden forms.

27. THUJA Arbor Vitae (Fig. 24D)

There are 5 species in Asia and North America. All species are of mountainous habitat and prefer shady moist situations. Numerous horticultural forms occur in the American Arbor Vitae, *T. occidentalis,* the most widely cultivated species.

28. THUJOPSIS Hiba Arbor Vitae (Fig. 24F)

The single species, *T. dolobrata,* originally from Japan, is a handsome ornamental tree resembling somewhat the Arbor Vitae in appearance but with larger foliage. It is possibly barely hardy in the Philadelphia region but it does not seem to be in actual cultivation here.

[1] See Morris Arboretum Bulletin, Vol. 4, p. 94. 1949.

29. TORREYA Torreya (Fig. 21B)

There are 6 species in discontinuous areas in warm temperate and subtropical Asia and North America. Two species occur in North America, one in Florida and the other in California. Most of the species, small handsome trees, are in cultivation while the most commonly planted one is Japanese Torreya, *T. nucifera* from Japan.

30. TSUGA Hemlock (Fig. 23A)

There are about 10 species, of the mountainous regions of eastern Asia and North America. The species thrive best along banks of rivers. In the eastern United States, besides the native *T. canadensis,* Common Hemlock, other species like Japanese Hemlock, *T. diversifolia* and Chinese Hemlock, *T. chinensis* and others also do well but the Pacific coastal species like Western Hemlock, *T. heterophylla* and others do not prove to be satisfactory.

Cultivated Spruces in the Philadelphia Area

JONATHAN W. WRIGHT[1]

The genus *Picea* (spruce) is one of the largest and most useful of the conifer genera. It contains about 31 species, nearly all of which grow on mountains or in northern latitudes. The spruces are useful horticulturally because of their dense foliage, regular crowns, and comparative freedom from pests. For these reasons they are favorites for landscape planting wherever large, erect evergreens are desired. Also, they are becoming favorites among Christmas tree growers and buyers. Spruce is also important to the wood-using industries of the northern United States, Canada, northern Europe, and northern Asia. In these regions there are millions of acres of spruce forests that yield a high grade of sulfite pulp valuable for the manufacture of newsprint and rayon.

Spruce needles are short (¼ to 1½ inches); they are sharp pointed; they are borne singly; and they are all of the same length on a given twig. The twigs are lined. The cones are pendant, medium-sized, have thin scales, and are usually borne only in the top of the crown. One or more of these characteristics may be used to distinguish spruce from pine (long needles borne in groups of 2 to 5, thick-scaled cones), fir (blunt needles, erect cones), hemlock (blunt needles of varying lengths, small cones borne over the entire crown), cedar (needles in clusters, erect cones), and other common conifers.

[1] The author is Geneticist, Northeastern Forest Experiment Station, U. S. Forest Service, Upper Darby, Pa. He is stationed at the Morris Arboretum, where many of the observations recorded in this paper were made.

Distinguishing one spruce from another is a more difficult task. For one thing, all the spruces lose their needles soon after being cut; and herbarium specimens quickly become just naked twigs and loose needles. This makes it difficult to compare fresh material with standard named specimens. For another thing, there are few species that have a single characteristic that is distinctive enough for positive identification. Among such species are Norway spruce (long cones), oriental spruce (very short, blunt needles), tigertail spruce (very thick, sharp needles), Himalayan spruce (long needles), and Serbian spruce (flat, soft needles). In other cases a combination of several different characteristics must be considered.

Although most of the spruces have been known for 50 years or more, and were introduced into the Philadelphia area more than 30 years ago, only three species are commonly met with outside of arboreta and large estates. Thus most of the growth observations recorded in this paper were made on a few arboretum trees, supplemented whenever possible by observations on trees in private yards or in forest plantings. No attempt was made to cover the entire Northeast, but a few pertinent observations on trees outside the Philadelphia area (particularly in Highland and Durand Eastman Parks, Rochester, N. Y.) have been included.

In a brief paper such as this, it is impossible to do more than mention the highlights of the most important species. Therefore, table 1 was prepared to give some growth information about all spruce species, including those not mentioned in the text.

Table 1. *Maximum sizes and growth rates of planted open-grown spruces on the grounds of the Morris Arboretum, Westtown School, and Haverford College, all near Philadelphia*[1].

Common name	Scientific name, *Picea*—	Age[2]	Total height	Height growth per year	Diameter breast high
		Years	*Feet*	*Feet*	*Inches*
	AMERICAN SPRUCES				
White	*glauca* (Moench) Voss	30	43	1.4	14
Blue	*pungens* Engelm.	47	34	1.4	10
Red	*rubens* Sarg.	8	10	1.2	2
Black	*mariana* (Mill.) B. S. P.	47	29	.6	8
Engelmann	*Engelmannii* Parry	29	35	1.2	10
Sitka	*sitchensis* (Bong.) Carr.	17	8	.5	1
Brewer	*Breweriana* S. Wats.	18	3	.2	—
	EUROPEAN SPRUCES				
Norway	*Abies* (L.) Karst	33	65	2.1	18
Oriental	*orientalis* (L.) Link.	50	75	1.5	16
Serbian	*omorika* (Pancic) Purkyne	30	50	1.7	10
	JAPANESE SPRUCES				
———	*Maximowiczii* Reg.	37	48[3]	1.7	14
Tigertail	*polita* (Sieb. and Zucc.) Carr	45	45	1.0	13
Koyamai	*Koyamai* Shirasawa	25	32	1.3	11
Alcock	*bicolor* (Maxim.) Mayo	27	23	.8	10
Sakhalin	*Glehnii* (Fr. Schmidt) Masters	17	17	1.0	7
Yeddo	*jezoensis* (Sieb. and Zucc.) Carr.	15	14	.9	4
	CHINESE SPRUCES				
———	*asperata* Masters	40	46	1.2	12
———	*retroflexa* Masters	28	15	.5	4
———	*Balfouriana* Rehd. and Wilson	28	18	.6	6
———	*montigena* Masters	28	20	.7	8
———	*Wilsonii* Masters	17	17	1.0	5
———	*purpurea* Masters	17	15	.9	3
———	*brachytyla* Masters	16	6	.4	1
	OTHER ASIATIC SPRUCES				
Himalayan	*Smithiana* Boiss.	18	8	.4	1
———	*Schrenkiana* Fisch. and Meyer	30[4]	21	.7	8
Siberian	*obovata* Ledeb.	14	16	1.1	4

[1] Data are included on all species except the Mexican *P. chihuahuana* Martinez, the Himalayan *P. spinulosa* (Griff.) Henry, and the Formosan *P. morrisonicola* Hayata, of which the author has seen no specimens.

[2] The ages refer to the period since the tree was 1 foot tall.

[3] A large portion of the crown broke off several years ago.

[4] This specimen is located in Durand Eastman Park, Rochester, N. Y. The species is not represented in the Philadelphia area.

The American Spruces

White spruce *(Picea glauca* (Moench) Voss) has the largest natural range of any American species. Extensive forests are found in New England and eastern Canada, and across Canada and Alaska almost to the Pacific Ocean. Since this is so, it is peculiar that its large-scale use for ornamental and forest planting is a recent phenomenon. Planted trees more than 30 years old are a rarity, but there are thousands less than 20 years old.

White spruce often has almost as blue foliage as the blue spruce. In Philadelphia it is faster growing in youth than the latter species, and for that reason is frequently used by new homeowners who need sizable trees at a reasonable price. The foliage color and sturdy branches have also brought this species into use as a Christmas tree in recent years. Some buyers object to the "cat" odor of the fresh needles, but this is largely dissipated if the trees are cut and stored outside for a few days before being brought into a warm room.

In late summer white spruce drops its needles of the previous year. The browning needles make the trees appear sickly for a period of 2 or 3 weeks. This is a regular annual occurrence, and it need not cause concern.

The blue spruce *(Picea pungens* Engelm.) Fig. 25, is a native of high altitudes in the southern Rocky Mountains. It grows slowly in youth and therefore is a fairly expensive tree to buy. People rarely plant it in large numbers, yet there is hardly a village in the Northeast which does not have at least one or two nice specimens up to 50 feet tall. It grows well in Philadelphia, and even better in the cooler parts of the Northeast.

The foliage of this species is not always blue. In an ordinary seedling population one may find blue, blue-green, or almost green trees. Some nurserymen grow only blue trees (usually of the Koster variety) by propagating with grafts or cuttings. Others grow seedlings and discard the greenest ones.

Red spruce *(Picea rubens* Sarg.) has been planted sparingly outside of arboreta even though it is native within 100 miles of Philadelphia. One probable reason for this is the difficulty of growing it in a nursery. One New York nurseryman who grows most species by the millions was able to grow only about 5,000 plantable trees in the best of four tries, even though the nursery is only a few miles from native stands. The planted trees look and grow about the same as wild trees. They are short-needled, dark green, dense-crowned, and of moderately fast growth.

Engelmann spruce *(Picea Engelmannii* Parry) is another species from the Rocky Mountains that appears promising in the Philadelphia area. It is often as blue and as fast-growing as blue spruce but has a more ragged crown.

Figure 25. Blue spruce has been planted in almost every part of the northeast.

The European Spruces

The three European species—Norway, Serbian, and Oriental spruce — were introduced into the Philadelphia area earlier than any other species except blue spruce. Therefore the trees have reached larger sizes than other species. All three thrive here, growing as fast as they do in their native lands, and as fast as or faster than the American spruces.

Norway spruce *(Picea Abies* (L.) Karst) is the second most important tree species of Europe. (Fig. 26.) It is the backbone of the Scandinavian pulp and paper industry and it provides lumber throughout northern Europe. It got its big start here in 1876 when an enterprising nurseryman offered potted seedlings for sale at the Centennial Exposition in Philadelphia. They sold well, and many of those seedlings, now 80-year-old veterans, are still living in Pennsylvania and New Jersey farmyards. The species has been used as an ornamental ever since, and trees of almost all ages are to be found throughout the Northeast. Large-scale forest planting started in the early 1900's in the Adirondack Mountains of New York. Many of those early plantations are now producing lumber and pulpwood. They provided the stimulus for planting thousands of acres during the last three decades.

Like the other spruces, Norway spruce sheds its needles quickly if cut and allowed to dry out. However, cut trees retain their needles very well if

left standing in water. As people have discovered this, many—including myself—have come to prefer the dense, full-crowned Norway spruce for their Christmas trees.

The large cones of Norway spruce furnish seeds for the next crop of trees. They also serve as models for many Christmas card and clock designers. The winding weights of traditional German cuckoo clocks are usually reproductions of *Fichtenzapfen* (spruce cones).

In young Norway spruce up to 25 or 30 feet tall the branches are horizontal or ascend slightly. Some trees retain this branching habit throughout life. In others the large branches bend downward and the large twigs near the ends of the branches may hang almost vertically as the trees grow older. Such older trees have a gracefully drooping appearance unmatched in other evergreens.

Oriental spruce *(Picea orientalis* (L.) Link.) is a native of the Caucasus Mountains of Asia Minor, where it grows at elevations of 3,000 to 7,000 feet in mixture with fir and pine. (See Cover.) In its homeland it grows to a maximum height of 180 feet. The largest trees in the Philadelphia area are now only about 75 feet tall, but they are still vigorous, and give reason for us to believe that we may expect giants here as well as in Asia Minor. This species also grows well near Poughkeepsie, N. Y., and in Rochester, N. Y.

Figure 26. Norway spruce is the fastest growing of the spruces.

Figure 27. The dense foliage and gracefully curving branches are characteristic of Serbian spruce.

There are several 50- to 60-year-old oriental spruces in the Philadelphia area, but younger trees are rare. Probably only one or two nurserymen ever distributed the species. This is difficult to imagine, for the tree is handsome, with its dense dark green foliage and narrow, regular crown. Perhaps, as with the red spruce, the difficulty of growing nursery stock is the reason. We recently tried to grow several thousand seedlings for a forestry planting. The seed germinated well but the seedlings died off from various causes until only a few were left at the end of 3 years.

The Serbian spruce *(Picea omorika* (Pancic) Purkyne) is my favorite. (Fig. 27.) It has very fine branches that sweep downward and upward gracefully, even in young trees. The upper surface of the flat needles is dark green, and the lower surface is whitish. On a windy day this contrast in needle color gives the tree a two-toned effect. The trees start to cone early—often when only 8 or 10 feet tall—and retain their cones for years after they ripen.

The present natural range of the Serbian spruce is limited to a very small area about 20 miles long in the Drina River basin of Yugoslavia, although in prehistoric times it seems to have ranged as far north as Czechoslovakia. This already small natural range seems to be decreasing. One might expect

such a delicate species to be a total failure when planted outside its native habitat; but it thrives in Philadelphia, Rochester, and several places in northern Europe. It is even fairly easy to grow in the nursery, and should become a standard nursery item as people become better acquainted with its graceful form.

The Japanese Spruces

Six species of spruce are found in the mountains of Japan or Sakhalin. They are dissimilar botanically and genetically but all of them grow moderately well to very well in Philadelphia.

Picea Maximowiczii Reg. is the fastest growing of the Japanese species. (Fig. 28.) It has thin, sharp needles and a regular, light-green crown. Although planted only in arboreta, it deserves attention from homeowners and foresters. The trees grow almost as fast as Norway spruce. This species shares with the Sitka spruce the interesting habit of "feathering" or developing new branches on the lower trunk of open grown specimens if the lower branches are cut.

The tigertail spruce thoroughly deserves its common name but not its scientific name—*Picea polita* (Sieb. and Zucc.) Carr. Its stout needles are extremely sharp, making a twig of blue spruce seem almost like a featherbed by comparison. It is thrifty but slow-growing in plantings in Philadelphia and Rochester, and will probably be planted only as a curiosity.

Figure 28. Maximowicz spruce is a fast growing Japanese species which merits attention from foresters and horticulturists.

Figure 29. Koyamai spruce was known for years from only a single stand in Japan.

The Koyamai spruce *(Picea Koyamai* Shirasawa) was first described in 1913 from Japan, where it is an extremely rare tree occurring in two groves on one mountain. (Fig. 29.) Later it was described from Korea and Manchuria, where it is an important timber tree. In spite of its recent introduction into the Occident, it has already established a reputation as a potentially valuable timber and ornamental tree in places as far apart as Finland, Illinois and Pennsylvania. The Morton Arboretum near Chicago has a small, closely spaced forest planting which is growing about as fast as any spruce in the area although it suffered winter browning on one occasion. The four Philadelphia specimens (probably one pair is from Japan, and the other pair is from Korea) are fast-growing and hardy. They are similar in general appearance to the Norway spruce, but are slightly broader crowned and have a little grayer foliage.

The Alcock spruce is a very rare tree with us, even in arboreta. It derives its scientific name—*Picea bicolor* (Maxim.) Mayr — from the two-toned color of the foliage. The single specimen at the Morris Arboretum is thrifty and has a broad, irregular crown. In an older specimen on the Hunnewell estate near Boston the lower branches have layered, giving a ring of young trees around the original one.

The Sakhalin *(Picea Glehnii* (Fr. Schmidt) Masters and Yeddo *(Picea jezoensis* (Sieb. and Zucc.) Carr. spruces from northern Japan and Sakhalin (the latter species also occurs on Kamtchatka and the Siberian mainland), perhaps find our climate a little too warm. Both are very slow-growing in Philadelphia, but the former is growing as fast as our native American species in Rochester and in Montgomery County, New York. The Yeddo spruce would make a desirable tree for foundation plantings and groups of small evergreens because of its two-toned foliage and compact growth habit.

Other Asiatic Spruces

The Chinese spruces are of more interest to botanists than to horticulturists and foresters. They occur naturally in the rugged mountains of western China, far from the normal tourist routes, and are known to western botanists only through the writings of plant explorers such as Masters, Wilson, Hu, and Teng, and through a few arboretum and herbarium specimens. On the whole they have shown less growth promise than most of the European and Japanese species.

Picea asperata Masters, which comes from a part of China that has a climate similar to that of Philadelphia, grows the fastest of the planted Chinese spruces. It is similar in general appearance to Norway spruce, but is broader crowned and has thinner, grayer foliage. Some of the varieties that have been tested near Philadelphia are more shrublike and have denser, bluer foliage than the typical species.

One of the Chinese spruces, *Picea montigena* Masters, has blue needles similar to those of blue spruce. The two Philadelphia specimens of this species are thrifty but slow-growing, and have very broad, irregular crowns. The female flowers are showy, even in comparison with some of the annuals commonly grown in gardens. They are almost 2 inches long, and are a brilliant crimson. Unfortunately they are not seen by many people since they are hidden in the tops of the trees and are showy for only a few days.

Where To Obtain Spruce Seed and Seedlings

Three spruces — Norway, white, and blue — are commonly available in commercial nurseries that handle ornamental stock. The first two are also available from most state forest tree nurseries. Most of the other species have been stocked only rarely and for short intervals by nurseries that specialize in rare plants.

Seed of Norway, white, blue, Engelmann, sitka *(Picea sitchensis* (Bong.) Carr.) and red spruce is commonly available from commercial houses handling tree seed. Good quality crossed seed of Oriental and Serbian spruce can be collected from occasional planted groups of two or more trees of these species, and is sometimes available commercially. Seed of the lower-altitude Japanese species *(P. polita, P. bicolor, P. Glehnii,* and *P. jezoensis*) may be obtained without great trouble by arrangement with local collectors. Native-grown seed of most other species is difficult to obtain because of the inaccessibility of the forest stands.

It usually does not pay to collect seed from planted trees of any but the commonest species. In isolated trees there is no opportunity for adequate cross-pollination; and the seed is usually empty, selfed, or hybrid. Neither the selfed nor the hybrid seed gives trees like their parents.

Spruce seedlings grow very slowly at first, requiring regular watering, weeding, and shading. The amateur is usually not well enough equipped to do these tasks at the right time. Therefore it is usually best to contract with a commercial nurseryman experienced in handling coniferous seedlings for the production of more than a few trees. If a few trees are desired, they may be propagated by grafting. This is especially recommended for species of which good seed is difficult to obtain.

ARBORETUM ACTIVITIES

(Continued from page 46)

senting 41 species of oaks from 33 states and 7 foreign countries.

The acorns which were sent in during the autumn of 1953 were planted in the rodent-proof seed beds described in Vol. 5, p. 54. In the spring of 1955 the seedlings, then approximately 18 months old, were transplanted to the Quercetum nursery. The time has now come to move these young trees to their permanent position in the Arboretum. The site which has seen selected is a broad strip which runs parallel to the extreme northwestern boundary, adjacent to the Widener estate, and then turns to extend southward along Stenton Avenue. Here during November nearly 250 three-year-old oaks were set out in accordance with a carefully determined planting plan.

In the allocation of these young oaks to their permanent positions the following principles have been adopted:

1. By planting the saplings 20 feet apart adequate space is provided for their future development as mature trees.

2. In order to facilitate comparative studies representatives of a given species are placed in the same section. Thus, specimens of White Oak from Massachusetts, Pennsylvania, New Jersey, Maryland, Virginia, North Carolina, Illinois, Arkansas and Texas will be found growing side by side. Another section will contain specimens of the Red Oak from various areas within its natural range of occurrence, and similarly with all the other species.

3. To compensate for possible differences in soil and to make possible statistical studies each seed lot is being replicated three times. For example, specimens of *Quercus alba* No. 009 (from Texas) will be planted in three different sections of the total strip and may be as much as 500 feet from each other.

4. Open spaces in the area allotted to each species are being left to be filled in by future outplantings. In the case of the White Oak, for instance, gaps are provided to accommodate examples of the seedlots acquired in 1954 which will be moved to their places in the autumn of 1957, and so on through succeeding years.

It is obvious that we have embarked upon a long-term experiment the full significance of which cannot be evaluated for many years.

Planting Plans

One of our chief concerns during recent months has been the preparation of a comprehensive plan for the establishment of new plantings on the tract lying to the north of Northwestern Avenue. This area, which was called Bloomfield by the Morris family and served as their farm, comprises about 70 acres. Except for having served as the site of several of our nurseries as well as the Langstroth Bee Garden and a few scattered plantings, this tract has been largely undeveloped by the Arboretum. It is now our intention to embark upon the ambitious program of moving into this area a series of plantings which will utilize its full potentialities and add significantly to the educational value of the Arboretum.

The first task has been the laying out of a roadway to provide access to the area. Our plan calls for an entrance off Northwestern Avenue some 150 feet to the east of the present gateway. From this point we have staked out a road which, following the contours of the land, first swings eastward, then follows northward paralleling Stenton Avenue, later turns west along the northern boundary of the property and finally articulates with an existing road which leads through a fine double avenue of sugar maples. One section of the proposed road will traverse a section of the oak plantings mentioned in the preceding section of these notes. Thus, as these trees develop to maturity an attractive driveway through a mixed oak stand will be provided.

In the development of a planting plan for this 70-acre tract we have adopted the principle of bringing together in one place as many examples of a given family or genus as is feasible. This concentration will enable visitors who are interested in a particular group of plants to see a large representation in a single location. For example, a series of Viburnums has already been established on a slope to the east of the proposed roadway; other species will be added until the planting contains all forms worthy of display which are hardy in this area. Near the Viburnums will be located other genera of the Honeysuckle Family, such as *Lonicera, Abelia, Weigelia, Symphoricarpus, Sambucus, Kolkwitzia* and *Diervilla.*

A large area near the entrance has been selected for the Rose Family and here will be exhibited the flowering cherries, crabs, cotoneasters, spiraeas and a multitude of other groups. The vast and important Legume Family, which includes redbud, locust, honey locust, yellow wood, pagoda tree, and many more, will find a home to the west of the new roadway along Northwestern Avenue. Space has been blocked out for several other groups, such as the barberries, the elms, the maples, the ashes, etc., while additional ones will be allocated as our plans mature. Future issues of the Bulletin will contain detailed information concerning the realization of these plans.

Recreation Area

Between the first of April and the end of October more than fifty groups scheduled outings at the Arboretum's Recreation Area. When this figure is compared with the thirty-eight such events held during the 1955 season it is apparent that this feature of the Arboretum's public service is increasing in popularity.

J. M. F., Jr.

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since September 1956:

Mrs. Carl H. Anderson
Dr. and Mrs. Russell A. Anthony
Mrs. James W. Banham
Miss June C. Berry
Mrs. Philip Bregy
Mrs. H. Herbert Breneman
Mr. and Mrs. E. M. Buckey
Mrs. J. Gibson McIlvain Bunting
Mrs. James Cheston, 4th
Dr. William Rex Crawford
Mrs. Robert Dale
Mrs. Lawrence Davidson
Mrs. Richard M. Decker
Mrs. William R. Dohan
Dr. T. McKean Downs
Mrs. Robert H. Dunn
Mr. David P. Earnshaw
Mrs. Xaver von Erdberg
Mrs. Charles A. Fife
Mrs. Edwin M. Finletter
Mrs. Merrill J. Fowle
Mrs. Richard L. Freeman
Mrs. John F. Gall
Mr. Wilbur B. Gantz
Mrs. Wm. Blake Gibson
Mrs. W. Charles Hogg
Mrs. Cooper Howell
Dr. Horace H. F. Jayne
Miss Anne Jelinek
Mrs. Wm. Linton Landreth
Mrs. Thomas W. Linn
Mr. Philip Atlee Livingston
Mr. Otto T. Mallery
Mrs. Stephen R. Manley, Sr.
Mrs. William S. McCurley, Jr.
Mr. and Mrs. Henry Mitchell
Dr. and Mrs. Harold Morris
Mrs. Josephine V. Mygatt
Mr. Albert J. Nesbitt
Mrs. Arthur E. Newbold, Jr.
Mrs. Henry G. Oas
Miss Ruth Perlmutter
Miss Marie W. Rumpp
Mrs. Paul Salzberg
Mr. Harry E. Sprogell
Miss Marjorie P. Stoops
Mrs. Kenneth E. Stuart
Mrs. Frank Graham Thomson
Mr. Robert H. Tice
Mrs. Jesse T. Vogdes
Mrs. Philip Wallis
Mrs. Harry F. West
Mrs. Walter H. West, Jr.
Mrs. Henry Lee Willet

We regret that due to an oversight, the name of Mr. Edward F. R. Wood was omitted from the list of New Associates printed in the September issue of the Bulletin.

Publications by Members of the Staff

The following books by members of the Staff of the Morris Arboretum are available at reduced prices to Associates:

Wherry, E. T. *The Genus Phlox*. Morris Arboretum Monograph III. 174 pages. Illust. Philadelphia 1955. $4.00. Price to Associates, $3.00

Wherry, E. T. *Wild Flower Guide*. 202 pages. 106 plates. New York 1948. $3.50. Price to Associates, $3.00

Wherry, E. T. *Guide to Eastern Ferns*. 220 pages. Illust. Lancaster 1937. $2.00. Price to Associates, $1.50

Li, H. L. *Chinese Flower Arrangement*. 122 pages. 10 figs. 20 plates. Philadelphia 1956. $4.00. Price to Associates, $3.50

Fogg, J. M., Jr. *Weeds of Lawn and Garden*. 215 pages. 176 figs. Philadelphia 1945. $2.50. Price to Associates, $2.00

Please send orders and remittances to:

The Associates of the Morris Arboretum
The Morris Arboretum
9414 Meadowbrook Avenue
Philadelphia 18, Pa.

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